US011833992B2

(12) **United States Patent**
Kang

(10) **Patent No.: US 11,833,992 B2**
(45) **Date of Patent: Dec. 5, 2023**

(54) **OCCUPANT RESTRAINING APPARATUS, AND CONTROL SYSTEM AND METHOD THEREOF**

(71) Applicants: **Hyundai Motor Company**, Seoul (KR); **Kia Corporation**, Seoul (KR)

(72) Inventor: **Seung-Kyu Kang**, Hwaseong-si (KR)

(73) Assignees: **Hyundai Motor Company**, Seoul (KR); **Kia Corporation**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **17/880,330**

(22) Filed: **Aug. 3, 2022**

(65) **Prior Publication Data**

US 2023/0211748 A1 Jul. 6, 2023

(30) **Foreign Application Priority Data**

Dec. 30, 2021 (KR) 10-2021-0192715

(51) **Int. Cl.**
B60R 21/233 (2006.01)
B60R 21/2338 (2011.01)
B60R 21/08 (2006.01)
B60R 21/02 (2006.01)

(52) **U.S. Cl.**
CPC ***B60R 21/233*** (2013.01); ***B60R 21/08*** (2013.01); ***B60R 21/2338*** (2013.01); *B60R 2021/028* (2013.01); *B60R 2021/23388* (2013.01)

(58) **Field of Classification Search**
CPC ... B60R 21/233; B60R 21/08; B60R 21/2338; B60R 2021/028; B60R 2021/23388
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

9,346,417	B2 *	5/2016	Sitko	B60R 13/0275
10,507,783	B2 *	12/2019	Rupp	B60R 21/231
10,864,876	B2 *	12/2020	Malapati	B60R 21/205
11,059,445	B2 *	7/2021	Malapati	B60R 21/232
11,247,632	B2 *	2/2022	Malapati	B60R 21/205
2016/0096491	A1 *	4/2016	Sitko	B60R 13/0275 280/730.2
2017/0050608	A1 *	2/2017	Meissner	B60R 21/232
2018/0186328	A1 *	7/2018	Raikar	B60R 21/08
2019/0256029	A1 *	8/2019	Ghannam	B62D 25/04
2020/0172039	A1 *	6/2020	Ghannam	B60R 21/2035

FOREIGN PATENT DOCUMENTS

DE	202012006364	U1 *	11/2013	B60R 21/02
DE	202017001400	U1 *	5/2017	B60J 5/0468
DE	102016211046	A1 *	12/2017	
JP	2000062559	A *	2/2000	B60G 17/0185
KR	20090062962	A	6/2009	

* cited by examiner

Primary Examiner — Drew J Brown
(74) *Attorney, Agent, or Firm* — Slater Matsil, LLP

(57) **ABSTRACT**

An embodiment occupant restraining apparatus includes a base to be fastened to a body of a vehicle, a support having a first end hinge-connected to the base and a second end configured to support a deployed airbag, and a bellows configured to be expanded by gas to pivot the support. During deployment of the airbag, the bellows is configured to receive the gas in concert with the deployment of the airbag.

20 Claims, 10 Drawing Sheets

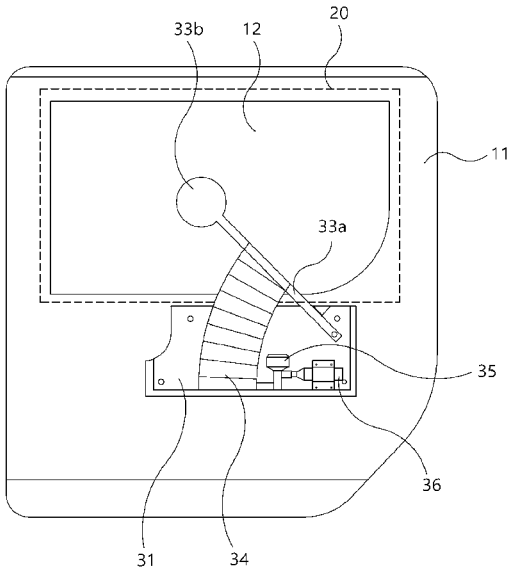


FIG. 1

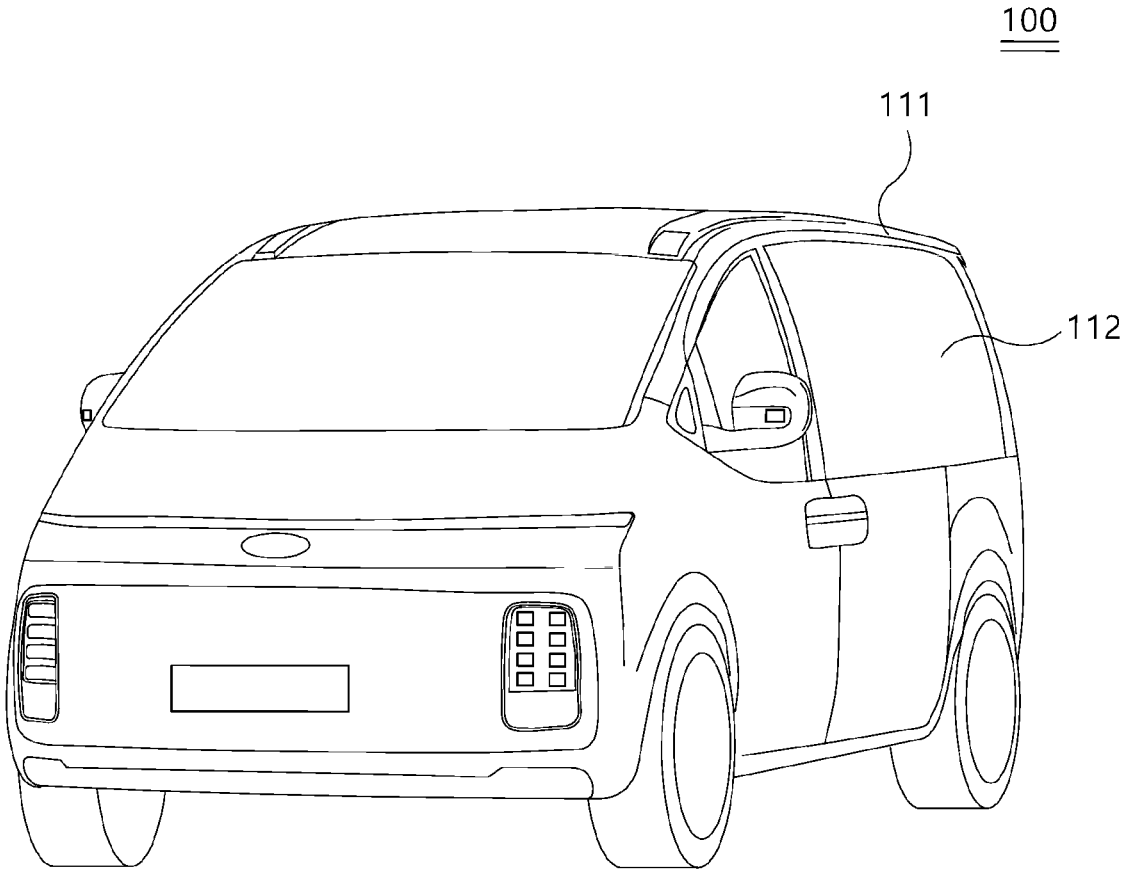


FIG. 2

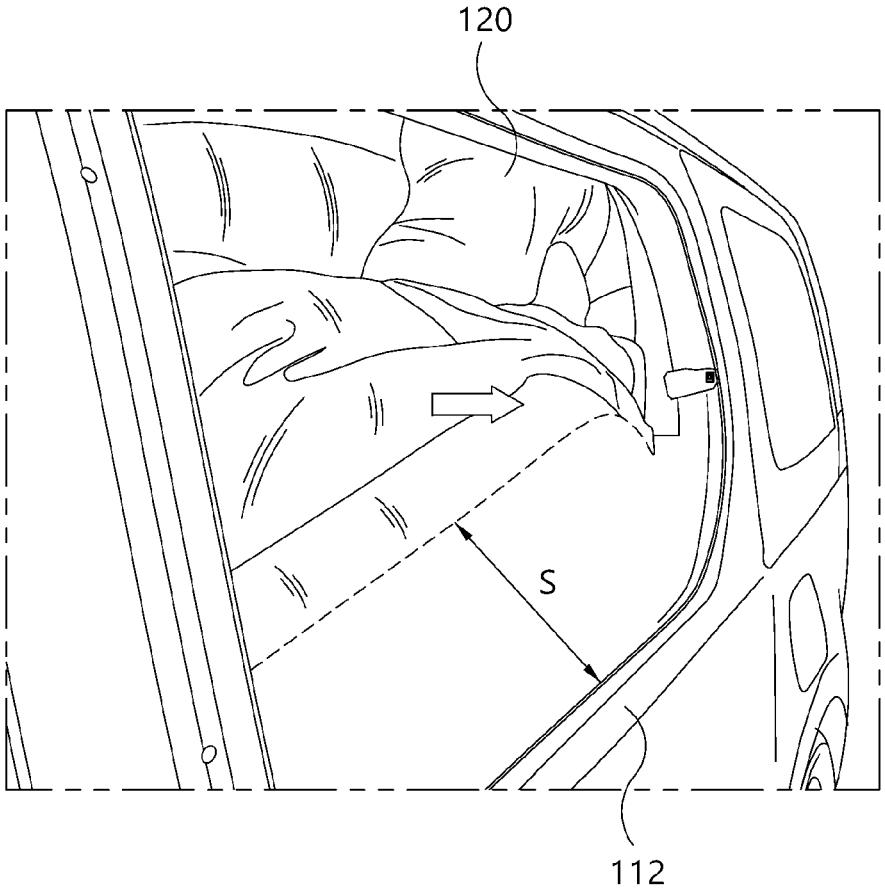


FIG. 3

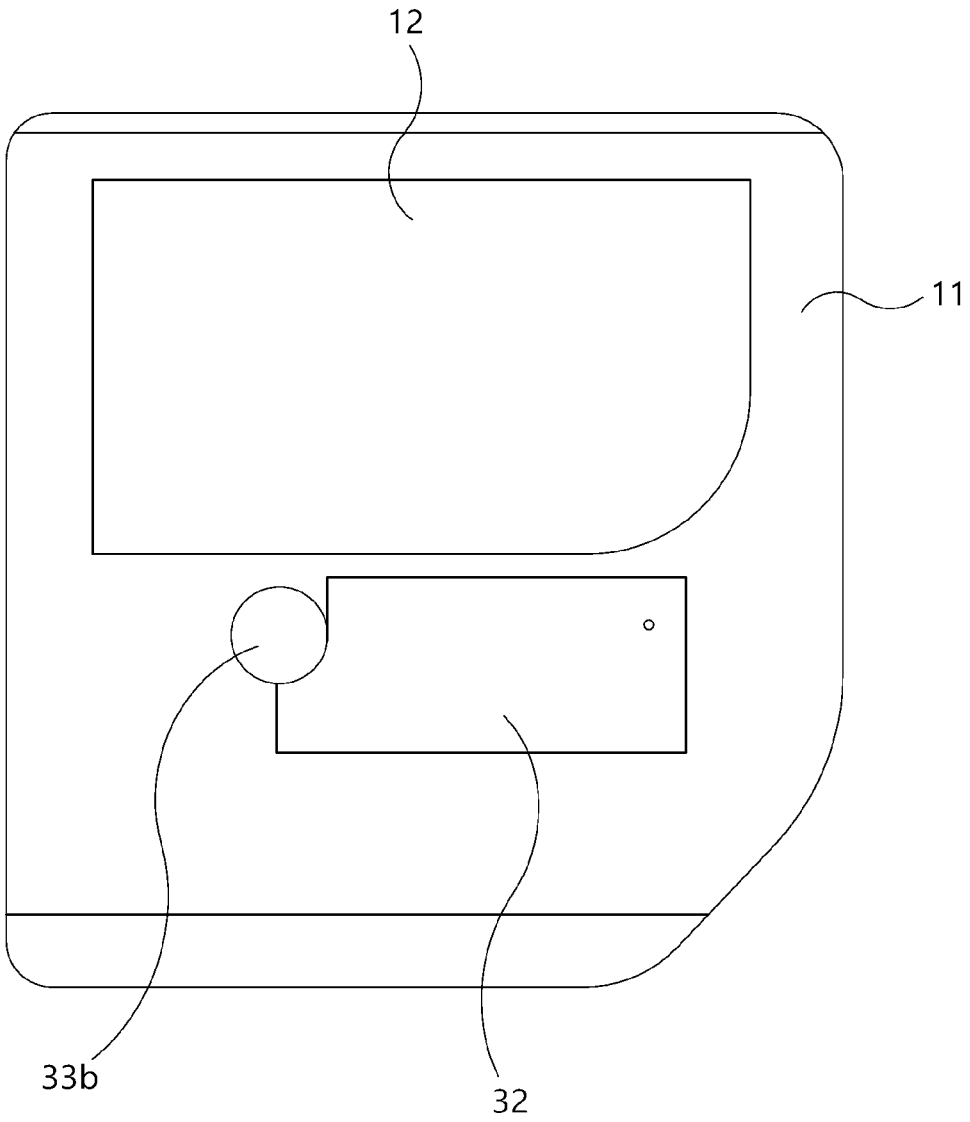


FIG. 4

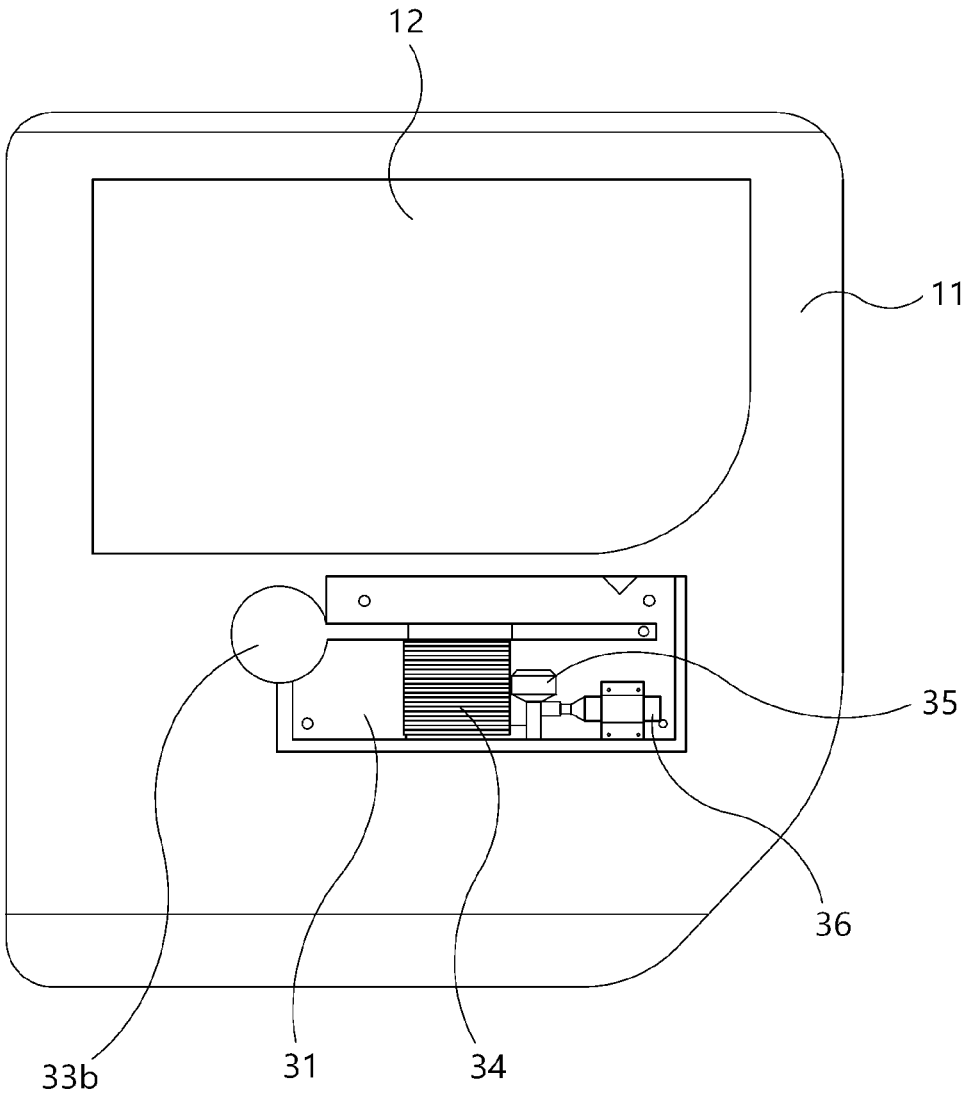


FIG. 5

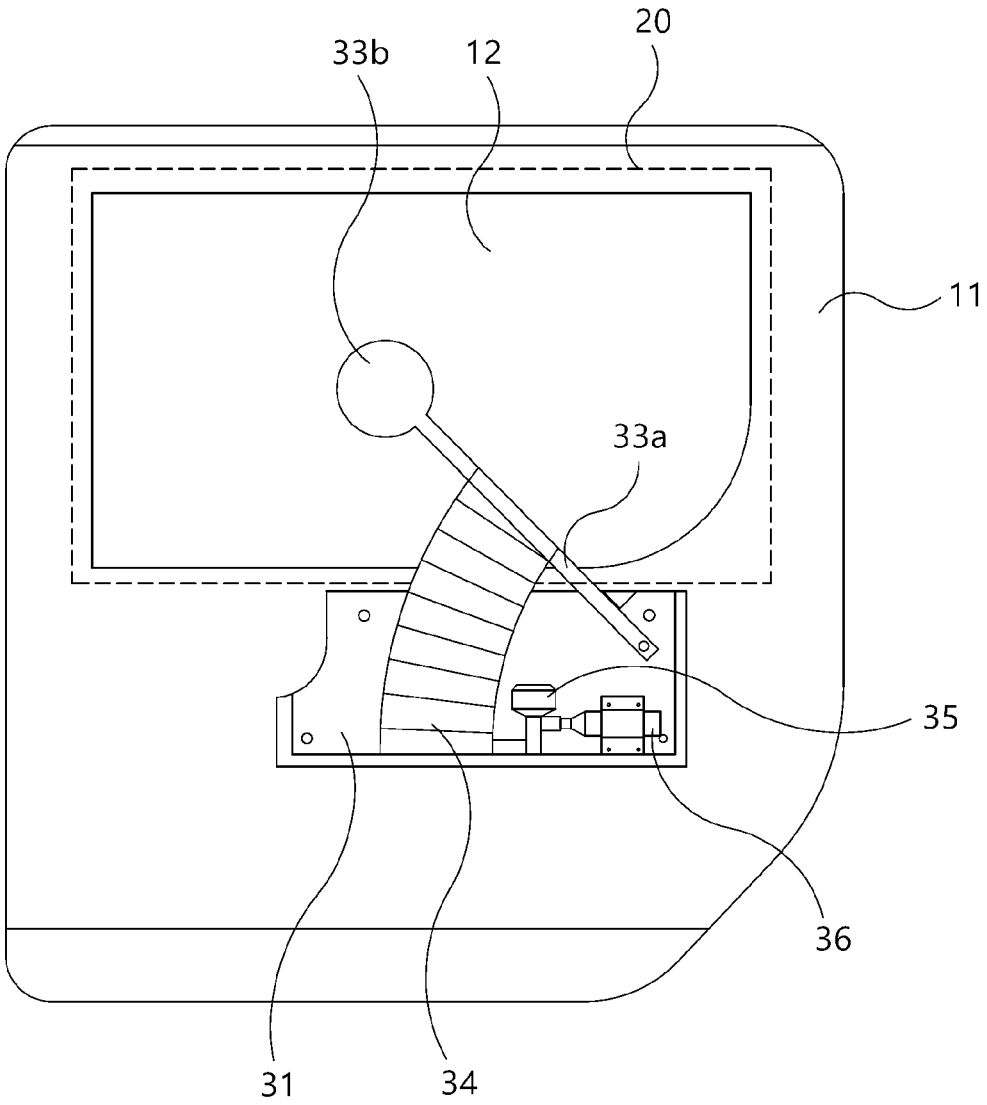


FIG. 6

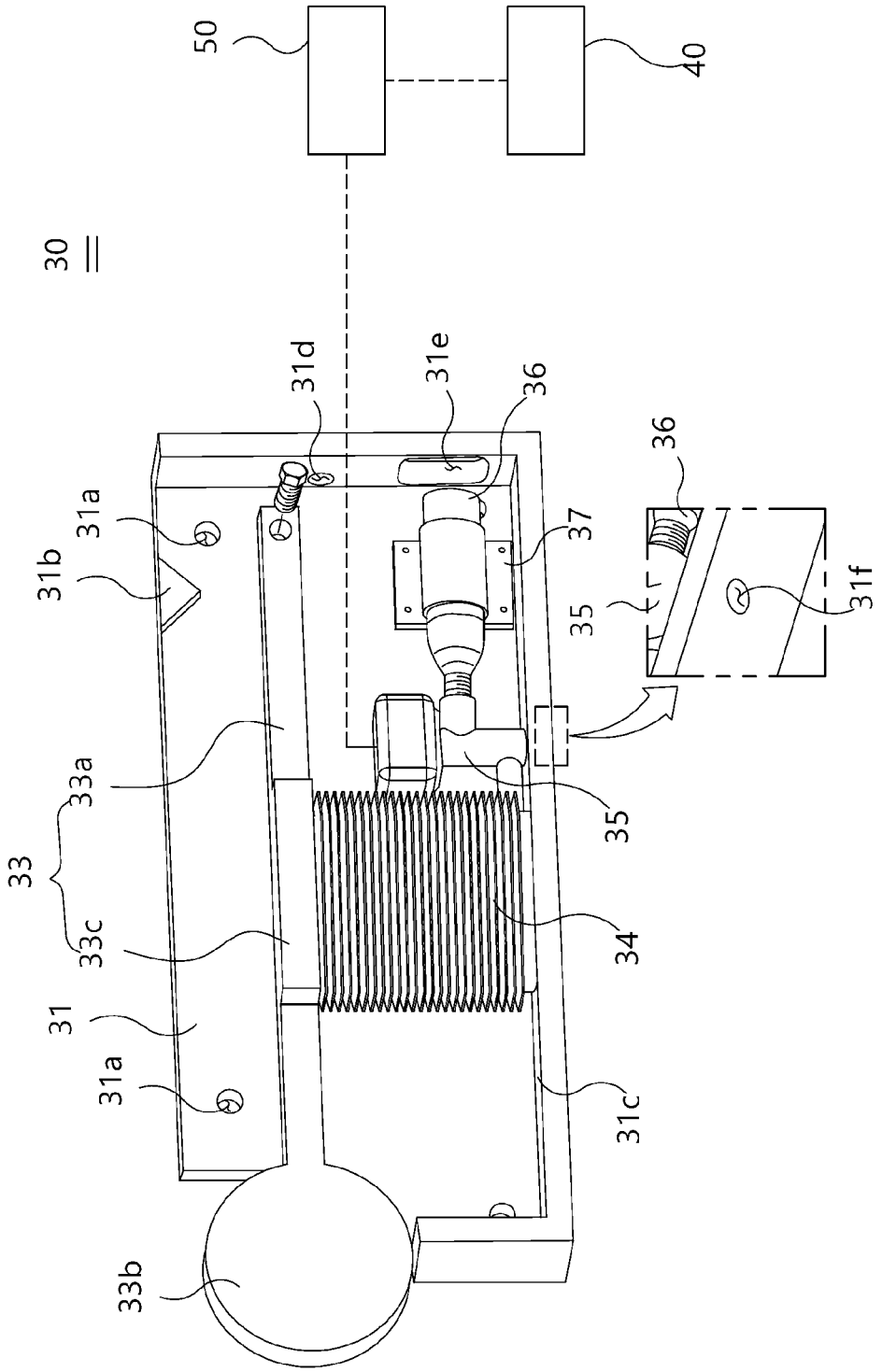

50
40
30
31d
31e
36
36
31a
31b
37
35
31f
33a
35
33
33c
34
31
31a
31c
33b

FIG. 7

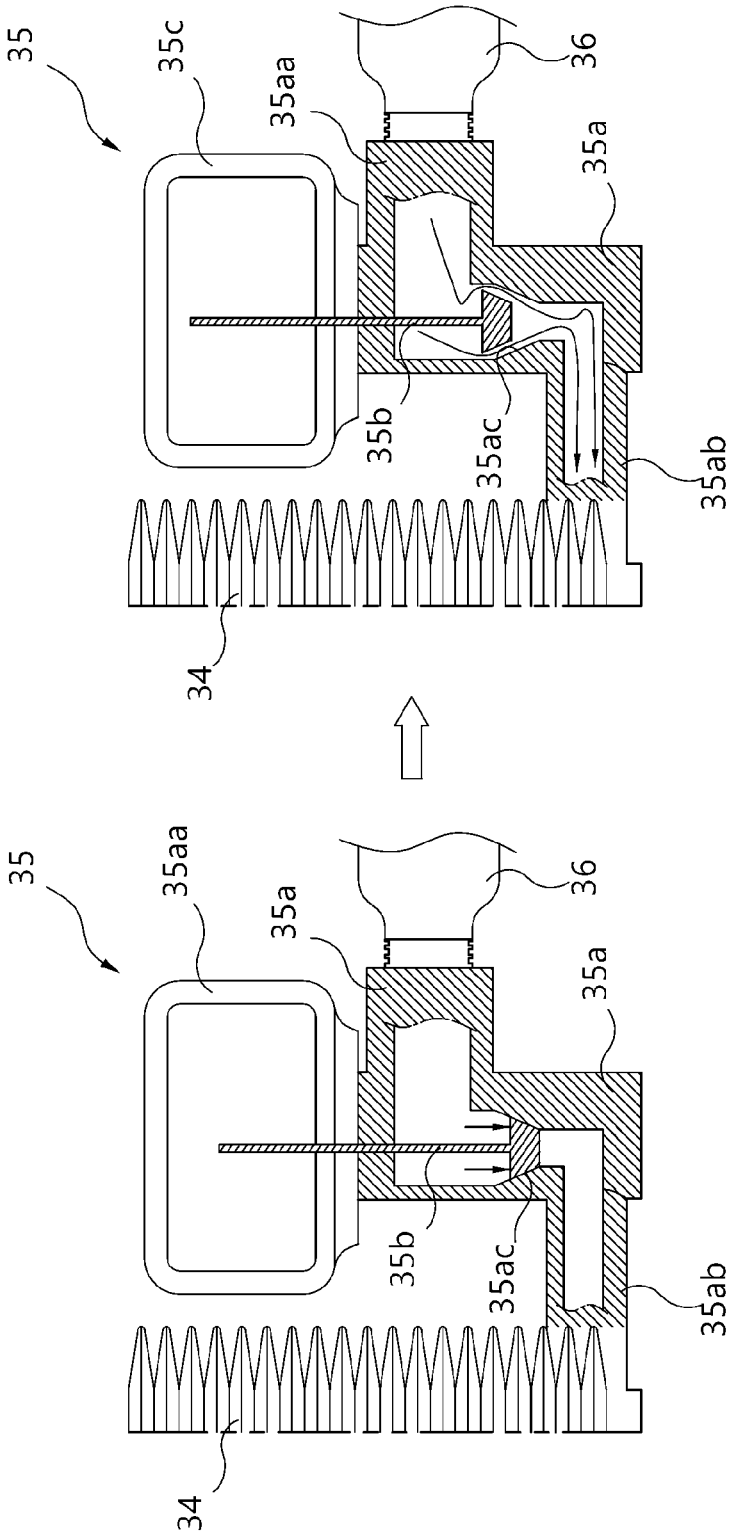

35
35c
35aa
36
35a
35b
35ac
35ab
34
35
35aa
35a
36
35a
35b
35ac
35ab
34

FIG. 8

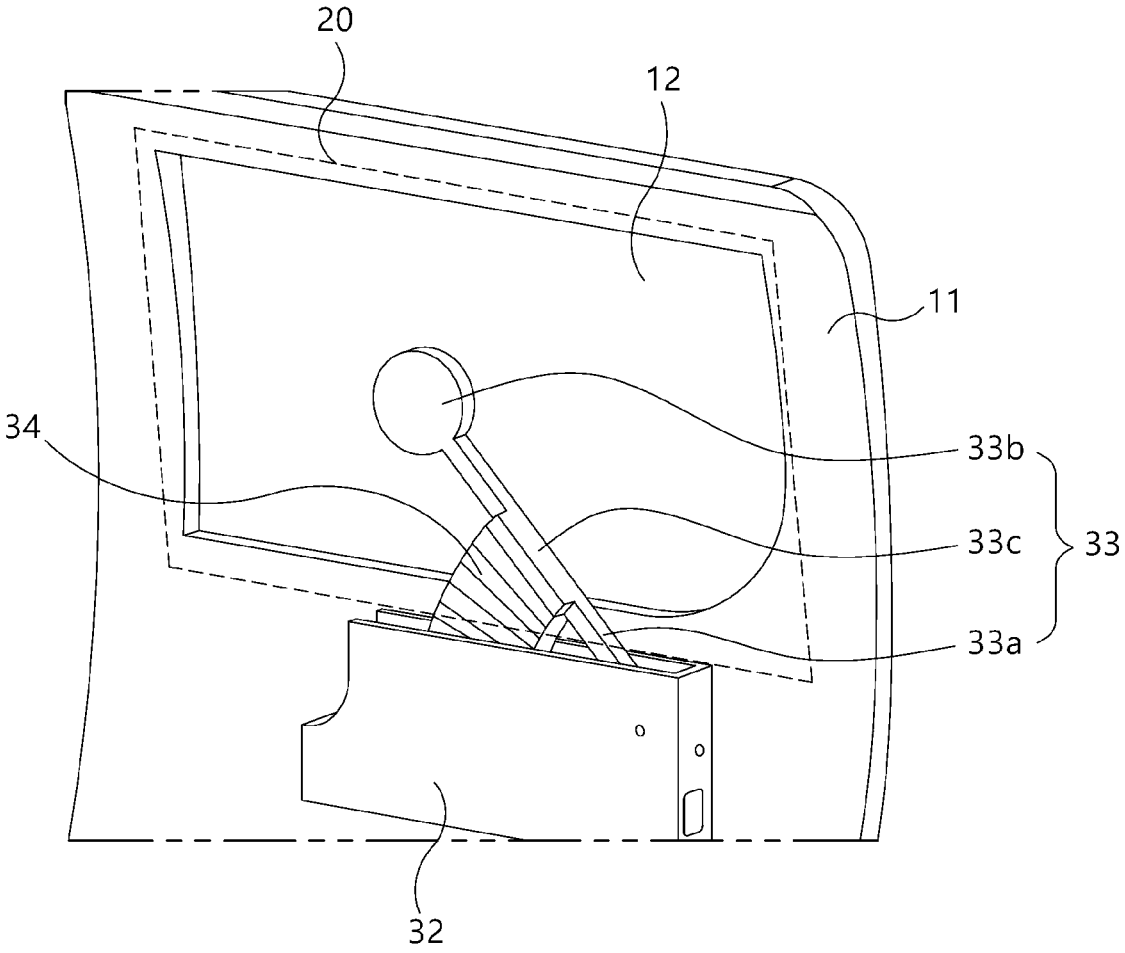


FIG. 9

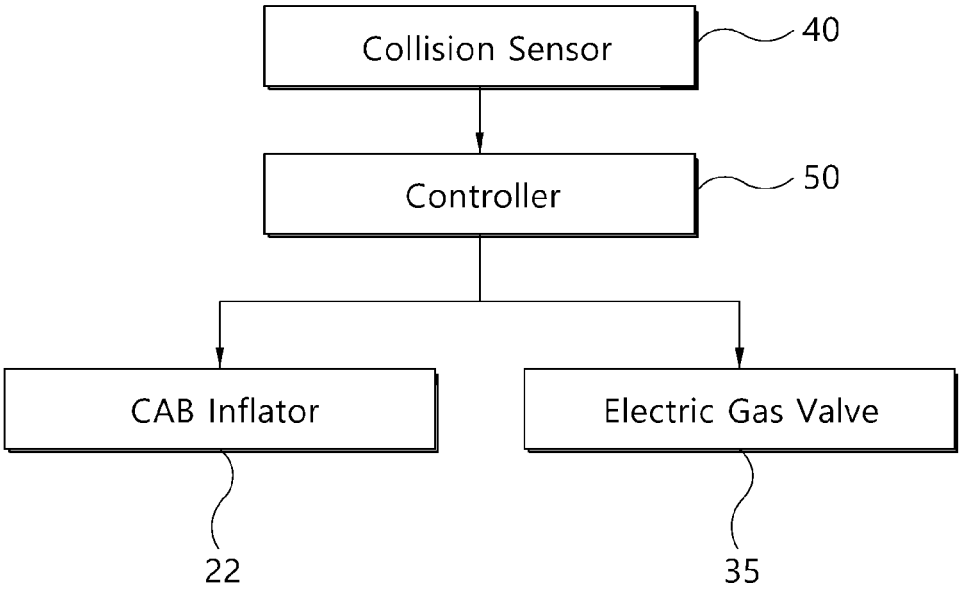
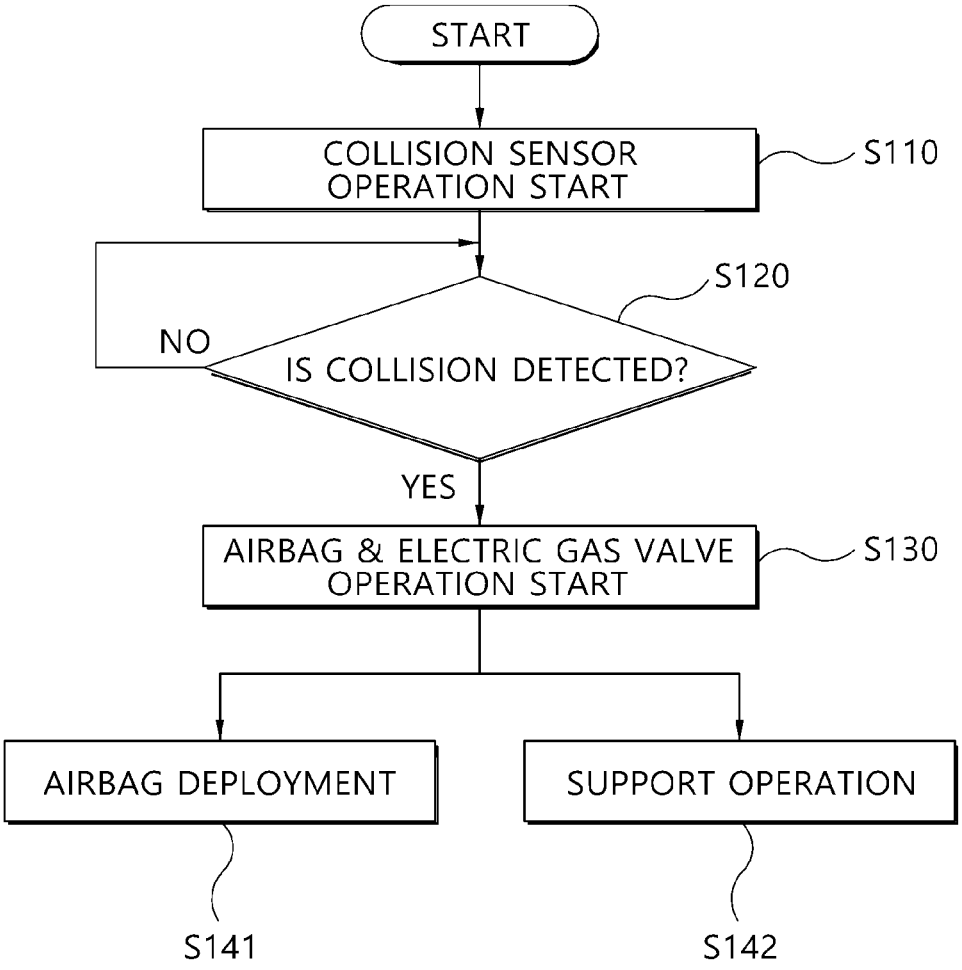

Collision Sensor
40
Controller
50
CAB Inflator
Electric Gas Valve
22
35

FIG. 10


START
COLLISION SENSOR OPERATION START
S110
S120
NO
IS COLLISION DETECTED?
YES
AIRBAG & ELECTRIC GAS VALVE OPERATION START
S130
AIRBAG DEPLOYMENT
SUPPORT OPERATION
S141
S142

OCCUPANT RESTRAINING APPARATUS, AND CONTROL SYSTEM AND METHOD THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of Korean Patent Application No. 10-2021-0192715, filed on Dec. 30, 2021, which application is hereby incorporated herein by reference.

TECHNICAL FIELD

The present disclosure relates to an occupant restraining apparatus and a control system and method of the occupant restraining apparatus.

BACKGROUND

A vehicle is provided with a variety of safety devices for protecting an occupant from an accident, such as a collision.

For example, there is an airbag system configured to deploy an airbag by exploding gunpowder when a vehicle collision is detected. Such airbag systems are increasingly mounted so as to cope with collisions in a plurality of directions. A curtain airbag, a side airbag, and the like are used to prevent the occupant from colliding with an inner surface or a door of the vehicle when a side collision is detected.

In a purpose built vehicle (PBV), a van, or the like, such as a vehicle **100** of FIG. **1**, a window **112** disposed on a side in of the vehicle is applied as a panoramic type to ensure the vision of the occupant and the size thereof is gradually increasing.

However, as the size of the window **112** increases, it is difficult for an airbag **120** to prevent the occupant from being released from the vehicle when the airbag **120** is deployed.

That is, as illustrated in FIG. **2**, even in the case that a curtain airbag **120** is deployed in response to the detection of a collision, an edge portion of the airbag **120** is not supported by a frame portion of the vehicle. When a portion of the body of an occupant is forced to be released from the vehicle due to the inertia in the collision, the body of the occupant presses the edge portion of the airbag **120**, so that a peripheral portion of the airbag is not supported by the frame portion. Thus, as the edge portion of the airbag **120** is deformed (as indicated with a dotted line in FIG. **2**), the distance between the airbag **120** and the frame portion forms a space S through which the occupant may be released from the vehicle. As described above, since the occupant is not restrained by the airbag **120**, there is a problem in that the occupant may be released outward through the space S.

SUMMARY

The present disclosure relates to an occupant restraining apparatus and a control system and a method thereof. Particular embodiments relate to an occupant restraining apparatus configured to support a deployed airbag so that an occupant is not released from a vehicle when an airbag is deployed in the case in which a vehicle collision is predicted, in the event of a collision, or the like, and a control system and method of the occupant restraining apparatus.

Accordingly, an embodiment of the present disclosure provides an occupant restraining apparatus configured to support the rear surface of an airbag in order to prevent an occupant from being released due to the deformation of a peripheral portion of the airbag when the airbag, such as a curtain airbag or a side airbag, is deployed, and a control system and method thereof.

An embodiment of the present disclosure provides an occupant restraining apparatus including a base fastened to a body of a vehicle, a support having one end hinge-connected to the base and the other end supporting a deployed airbag, and a bellows configured to be expanded by gas to pivot the support. When the airbag is operated, the gas may be supplied into the bellows in concert with an operation of the airbag.

The support may include an arm having a predetermined length, with one end of the arm being hinge-connected to the base, and a support surface provided on the one end of the arm, having a predetermined area, and configured to support the deployed airbag.

An intermediate portion of the arm may have a width greater than those of other portions of the arm to form a bellows connecting portion connected to the bellows.

The bellows may have a bottom end fixed to the base and a top end connected to the support. When the gas enters the bellows, the bellows may be stretched upward to pivot the support.

The occupant restraining apparatus may further include a gas cartridge fixedly disposed on the base and configured to store the gas for expanding the bellows and an electric gas valve connecting the bellows and the gas cartridge and configured to allow the gas cartridge and the bellows to communicate with each other when the collision of the vehicle is detected.

The electric gas valve may include a body including a channel through which the gas cartridge and the bellows communicate with each other, an actuator configured to operate to open and close the channel, and a drive part configured to drive the actuator to open the channel when the collision of the vehicle is detected.

The gas cartridge may be fastened to the base through a cartridge bracket, the cartridge bracket being fixed to the base while surrounding the gas cartridge.

The base may include a stopper protruding therefrom and configured to limit an angle of pivoting of the support.

The occupant restraining apparatus may further include a cover configured to cover the base.

In another embodiment, also provided is a control system of an occupant restraining apparatus, the control system including a collision sensor configured to detect a collision of the vehicle and a controller configured to control, when the collision of the vehicle is detected by the collision sensor, an airbag to be deployed and simultaneously to operate an electric gas valve so that gas is supplied from a gas cartridge to a bellows that pivots a support supporting the airbag.

In another embodiment, also provided is a control method of an occupant restraining apparatus including a support configured to support an airbag deployed by pivoting, a bellows configured to pivot the support while being stretched by gas, a gas cartridge configured to store gas for expanding the bellows, and an electric gas valve connecting the bellows and the gas cartridge and configured to control supply of the gas from the gas cartridge to the bellows. The control method may include a sensor operation start step of starting an operation of the collision sensor to detect a collision of a vehicle, a collision detection determination step of determining, by a controller, whether or not the collision sensor has detected the collision of the vehicle, and an airbag and electric gas valve operation start step of

starting operations of the airbag and the electric gas valve when the controller determines that the collision sensor has detected the collision. After the airbag and electric gas valve operation start step, an airbag deployment step of deploying, by the controller, the airbag by operating an inflator of the airbag and a support operation step of operating, by the controller, the electric gas valve to supply the gas from the gas cartridge to the bellows to stretch the bellows so that the support is pivoted to support the airbag may be performed, and the airbag deployment step and the support operation step may be simultaneously performed.

According to the occupant restraining apparatus having the above-described configuration and the control system and method thereof according to embodiments of the present disclosure, when a curtain airbag or a side airbag is operated in response to a side collision or the like, the occupant restraining apparatus starts to operate simultaneously with the curtain airbag or the side airbag to support the rear surface of the airbag, thereby preventing a peripheral portion of the deployed airbag from being deformed.

Since the rear surface of the deployed airbag is supported without a deformation in the periphery of the airbag, it is possible to overcome a problem in that an occupant of a vehicle is released from the vehicle through a space between the airbag and the frame.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view illustrating a PBV to which a panoramic window is applied;

FIG. **2** is a perspective view illustrating a state in which the peripheral portion of an airbag is deformed in the event of a side collision according to the related art;

FIG. **3** is a front view illustrating an occupant restraining apparatus according to embodiments of the present disclosure;

FIG. **4** is a front view illustrating a state in which a cover is removed from the occupant restraining apparatus according to embodiments of the present disclosure;

FIG. **5** is a front view illustrating a state in which the occupant restraining apparatus according to embodiments of the present disclosure is operated;

FIG. **6** is a perspective view illustrating the internal structure of the occupant restraining apparatus according to embodiments of the present disclosure;

FIG. **7** is a cross-sectional view illustrating a flow of gas in response to the operation of the electric gas valve in the occupant restraining apparatus according to embodiments of the present disclosure;

FIG. **8** is a perspective view illustrating a state in which the occupant restraining apparatus according to embodiments of the present disclosure is operated;

FIG. **9** is a block diagram illustrating a control system of the occupant restraining apparatus according to embodiments of the present disclosure; and

FIG. **10** is a flowchart illustrating a control method of the occupant restraining apparatus according to embodiments of the present disclosure.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Hereinafter, an occupant restraining apparatus and a control method thereof according to embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

An occupant restraining apparatus **30** according to embodiments of the present disclosure includes a base **31** fastened to a body **11** of a vehicle **100**, a support **33** having one end hinge-connected to the base **31** and the other end supporting a deployed airbag **20**, and a bellows **34** configured to be expanded by gas to pivot the support **33**. When the airbag **20** is operated, the gas is supplied into the bellows **34** in concert with the operation of the airbag **20**.

The base **31** is fastened to the body of the vehicle, and accommodates therein respective components to be described later.

The base **31** is fastened to the body of the vehicle at a position adjacent to a portion of the vehicle on which a window **12** is formed. The base **31** has a fastening hole **31***a* through which the base **31** is fastened to the body **11** of the vehicle. The base **31** is fastened to the body of the vehicle using the fastening hole **31***a*.

A cover **32** covers the base **31** to protect components disposed inside the base **31**.

One end of the support **33** is hinge-connected to the base **31** in a pivotable manner. When the airbag **20** is deployed, the other end of the support **33** supports the airbag **20**.

The support **33** includes an arm **33***a* having one end hinge-connected to the base **31** and a support surface **33***b* having a predetermined area and configured to support the airbag **20**.

The arm **33***a* has a predetermined length, and is disposed inside the base **31** in a pivotable manner. Since one end of the arm **33***a* is hinge-connected to the base **31**, the arm **33***a* is pivotable.

The support surface **33***b* is formed at one end of the arm **33***a*, i.e., one portion of the arm **33***a* opposite the other portion of the arm **33***a* hinge-connected to the base **31**. The area of the support surface **33***b* is determined such that the support surface **33***b* may support the deployed airbag **20**. Since the airbag **20** has been filled with and deployed by the gas generated by the explosion of gunpowder, the support surface **33***b* having the predetermined area supports the deployed airbag **20**. Since the support surface **33***b* supports the deployed airbag **20**, it is possible to prevent the peripheral portion of the airbag **20** from being deformed by the inertia of the occupant tending to be released outward.

A bellows connecting portion **33***c* having a width greater than the width of the arm **33***a* is provided on a portion of the arm **33***a*. Since the width of the bellows connecting portion **33***c* is greater than the width of the arm **33***a*, it is possible to easily fix the bellows **34** to the support **33**.

The arm **33***a*, the support surface **33***b*, and the bellows connecting portion **33***c* are formed integrally with one another, thereby forming the support **33**.

In addition, a stopper **31***b* protrudes from the base **31**, thereby preventing the support **33** from pivoting beyond a predetermined angle. The support **33** may pivot until contacting the stopper **31***b* from the initial position.

When the gas is supplied into the bellows **34**, the bellows **34** is stretched upward.

The bottom end of the bellows **34** is fixed to one side of the base **31**, and the top end of the bellows **34** is fixed to the support **33**. When the bellows **34** is stretched upward, the bellows **34** pivots the support **33**. A bellows connecting surface **31***c* is formed such that the bottom end of the bellows **34** is reliably fixed to the base **31**. The bottom end of the bellows **34** is fixed to the bellows connecting surface sic. The top end of the bellows **34** is fixed to the bottom surface of the bellows connecting portion **33***c*. The top end and the bottom end of the bellows **34** may be fixed to the arm **33***a* and the base **31** by bonding.

A gas cartridge **36** stores the gas by which the bellows **34** is expanded. The gas stored in the gas cartridge **36** may be carbon dioxide. The gas cartridge **36** is fixed to the base **31** through a cartridge bracket **37**. The cartridge bracket **37** is fixed to the base **31** while surrounding the gas cartridge **36**.

In addition, the base **31** has an assembly hole **31***e* used when fastening the gas cartridge **36** to the base **31**.

An electric gas valve **35** is disposed between the gas cartridge **36** and the bellows **34** on the base **31** to supply the gas stored in the gas cartridge **36** to the bellows **34** by working in concert with the deployment of the airbag **20**.

In this regard, the electric gas valve **35** includes a body **35***a* having a channel through which the gas cartridge **36** and the bellows **34** communicate with each other, an actuator **35***b* configured to operate to open and close the channel, and a drive part **35***c* configured to drive the actuator **35***b* to open the channel when a collision of the vehicle is detected.

Since the channel is formed inside the body **35***a*, the gas cartridge **36** and the bellows **34** are connected to communicate with each other. The body **35***a* includes a cartridge connecting portion **35***aa* connected to the gas cartridge **36** and a bellows connecting portion **35***ab* connected to the bellows **34**. A portion of the body **35***a* between the cartridge connecting portion **35***aa* and the bellows connecting portion **35***ab* is hollow, thereby forming the channel. In addition, an opening/closing portion **35***ac* is formed in an intermediate portion of the body **35***a* so as to be opened and closed by the operation of the actuator **35***b*.

The actuator **35***b* opens and closes the channel with the opening/closing portion **35***ac*. The actuator **35***b* may operate to move the opening/closing portion **35***ac* from a closed state to an opened state while moving in the axial direction of the actuator **35***b*.

The drive part **35***c* drives the actuator **35***b*. The drive part **35***c* is implemented as a solenoid, an electric motor, or the like to drive the actuator **35***b*. The actuator **35***b* remains closing the opening/closing portion **35***ac* at ordinary time. When the airbag **20** is deployed, the drive part **35***c* drives the actuator **35***b* to open the opening/closing portion **35***ac*.

The electric gas valve **35** is fastened to the base **31** in response to a fastening bolt being fastened to a valve fastening hole **31***f* formed on the base **31**. In addition, a wire hole **31***d* is formed in the base **31**, and wires through which a control signal and power necessary for the operation of the electric gas valve **35** are input may be disposed through the wire hole **31***d*.

FIG. **7** illustrates a configuration in which the gas is supplied from the gas cartridge **36** to the bellows **34** in response to the operation of the electric gas valve **35**. That is, in a situation in which the actuator **35***b* closes the opening/closing portion **35***ac* (left section of FIG. **7**), when the drive part **35***c* drives the actuator **35***b* to open the opening/closing portion **35***ac*, the gas is supplied from the gas cartridge **36** to the bellows **34**.

FIGS. **6** and **9** illustrate a control system of the occupant restraining apparatus according to embodiments of the present disclosure.

The control system of the occupant restraining apparatus according to embodiments of the present disclosure is configured to control the operation of the above-described occupant restraining apparatus **30**.

A collision sensor **40** detects a collision of the vehicle. Particularly, the collision sensor **40** may be configured to detect a side collision of the vehicle.

A controller **50** controls the operation of the airbag **20** and the electric gas valve **35** on the basis of signals input from the collision sensor **40**.

That is, when a signal resulting from the detection of a collision is input from the collision sensor **40**, the controller **50** outputs a signal to operate the airbag **20**. For example, the controller **50** may operate a curtain airbag (CAB) inflator **22**.

At the same time, the controller **50** controls the electric gas valve **35** so that the drive part **35***c* drives the actuator **35***b*.

When the electric gas valve **35** is operated, the actuator **35***b* opens the channel to supply the gas from the gas cartridge **36** to the bellows **34**. When the gas is supplied into the bellows **34**, the bellows **34** is stretched to pivot the support **33**. When the support surface **33***b* is exposed to the window **12** in response to the pivoting of the support **33**, the deployed airbag **20** is supported by the support **33**.

The controller **50** may be an airbag control unit (ACU). When the controller **50** is the ACU, the controller **50** may additionally control the occupant restraining apparatus **30** while basically performing a function of controlling the operation of the airbag **20**.

FIG. **10** illustrates a control method of the occupant restraining apparatus according to embodiments of the present disclosure.

In a sensor operation start step S**110**, an operation of the collision sensor **40** that detects a vehicle collision is started. The sensor operation start step S**110** may be performed when the vehicle is in a key-on state or started.

In a collision detection determination step S**120**, the controller **50** determines whether or not the collision sensor **40** has detected a collision of the vehicle. Since the controller **50** and the collision sensor **40** are connected, when the collision sensor **40** detects the collision, the signal of the collision sensor **40** is input to the controller **50**, and the controller **50** detects the collision of the vehicle on the basis of the signal.

When the controller **50** detects the collision of the vehicle (YES to S**120**), an airbag and electric gas valve operation start step S**130** is performed. In the airbag and electric gas valve operation start step S**130**, the controller **50** starts controlling the airbag **20** and the electric gas valve **35**.

After the airbag and electric gas valve operation start step S**130**, an airbag deployment step S**141** and a support operation step S**142** are simultaneously performed. In the airbag deployment step S**141**, the controller **50** operates the inflator of the airbag **20** to deploy the airbag **20**. In addition, in the support operation step S**142**, the controller **50** operates the electric gas valve **35** to supply the gas from the gas cartridge **36** to the bellows **34**, thereby stretching the bellows **34**. Consequently, the support **33** is pivoted, thereby supporting the deployed airbag **20**.

Since the airbag **20** is deployed by the CAB inflator **22** based on the explosion of gunpowder, the deployment of the airbag **20** is finished faster than the bellows **34** operating in response to the expansion of the gas. However, since the support **33** supports the deployed airbag **20** before the occupant arrives at the deployed airbag **20**, it is possible to prevent the occupant from being released from the vehicle.

What is claimed is:

1. An occupant restraining apparatus comprising:

a base to be fastened to a body of a vehicle;

a support having a first end hinge-connected to the base and a second end configured to support a deployed airbag; and

a bellows configured to be expanded by gas to pivot the support, wherein, during deployment of the airbag, the bellows is configured to receive the gas in concert with the deployment of the airbag;

a gas cartridge fixedly disposed on the base and configured to store the gas for expanding the bellows; and

an electric gas valve connecting the bellows and the gas cartridge and configured to allow the gas cartridge and the bellows to communicate with each other in response to detection of a collision of the vehicle, wherein the electric gas valve comprises:

a body comprising a channel through which the gas cartridge and the bellows communicate with each other;

an actuator configured to operate to open and close the channel; and

a drive part configured to drive the actuator to open the channel in response to the detection of the collision of the vehicle.

2. The apparatus of claim **1**, wherein the support comprises:

an arm having a predetermined length and having a first end hinge-connected to the base; and

a support surface provided on the second end of the arm, the support surface having a predetermined area and configured to support the deployed airbag.

3. The apparatus of claim **2**, wherein an intermediate portion of the arm has a width greater than widths of other portions of the arm, and wherein the intermediate portion is connected to the bellows.

4. The apparatus of claim **1**, wherein the bellows has a bottom end fixed to the base and a top end connected to the support, and wherein, in response to the gas entering the bellows, the bellows is configured to stretch upward to pivot the support.

5. The apparatus of claim **1**, wherein the gas cartridge is fastened to the base through a cartridge bracket, the cartridge bracket being fixed to the base while surrounding the gas cartridge.

6. The apparatus of claim **1**, wherein the base comprises a stopper protruding therefrom and configured to limit an angle of pivoting of the support.

7. The apparatus of claim **1**, further comprising a cover configured to cover the base.

8. A control system of an occupant restraining apparatus, the control system comprising:

a collision sensor configured to detect a collision of a vehicle; and

a controller configured to control, in response to detection of the collision of the vehicle by the collision sensor, an airbag to be deployed and simultaneously to operate an electric gas valve so that gas is supplied from a gas cartridge to a bellows that pivots a support supporting the airbag;

wherein a base of the occupant restraining apparatus is fastened to a body of the vehicle;

wherein the support has a first end hinge-connected to the base and a second end supporting the airbag; and

wherein the gas cartridge is fixedly disposed on the base and is configured to store the gas for expanding the bellows; and

wherein the electric gas valve connects the bellows and the gas cartridge and is configured to allow the gas cartridge and the bellows to communicate with each other in response to the detection of the collision of the vehicle; and

wherein the electric gas valve comprises a body comprising a channel through which the gas cartridge and the bellows communicate with each other, an actuator configured to operate to open and close the channel, and a drive part configured to drive the actuator to open the channel in response to the detection of the collision of the vehicle.

9. The control system of claim **8**, wherein the support comprises:

an arm having a predetermined length and having a first end hinge-connected to the base; and

a support surface provided on the first end of the arm, the support surface having a predetermined area and configured to support the airbag.

10. The control system of claim **9**, wherein an intermediate portion of the arm has a width greater than widths of other portions of the arm, and wherein the intermediate portion is connected to the bellows.

11. The control system of claim **8**, wherein the bellows has a bottom end fixed to the base and a top end connected to the support, and wherein, in response to the gas entering the bellows, the bellows is configured to stretch upward to pivot the support.

12. The control system of claim **8**, wherein the gas cartridge is fastened to the base through a cartridge bracket, the cartridge bracket being fixed to the base while surrounding the gas cartridge.

13. The control system of claim **8**, wherein the base comprises a stopper protruding therefrom and configured to limit an angle of pivoting of the support.

14. The control system of claim **8**, further comprising a cover configured to cover the base.

15. A vehicle comprising:

a vehicle body;

a base fastened to the vehicle a body;

an airbag;

a support having a first end hinge-connected to the base and a second end configured to support the airbag; and

a bellows configured to be expanded by gas to pivot the support, wherein, during deployment of the airbag, the bellows is configured to receive the gas in concert with the deployment of the airbag;

a gas cartridge fixedly disposed on the base and configured to store the gas for expanding the bellows; and

an electric gas valve connecting the bellows and the gas cartridge and configured to allow the gas cartridge and the bellows to communicate with each other in response to detection of a collision of the vehicle, wherein the electric gas valve comprises:

a body comprising a channel through which the gas cartridge and the bellows communicate with each other;

an actuator configured to operate to open and close the channel; and

a drive part configured to drive the actuator to open the channel in response to the detection of the collision of the vehicle.

16. The vehicle of claim **15**, further comprising:

a collision sensor configured to detect a collision of the vehicle; and

a controller configured to control, in response to detection of the collision of the vehicle by the collision sensor, the airbag to be deployed and simultaneously to operate the electric gas valve so that gas is supplied from the gas cartridge to the bellows that pivots the support.

17. The vehicle of claim **15**, wherein the support comprises:

an arm having a predetermined length and having a first end hinge-connected to the base; and

a support surface provided on the second end of the arm, the support surface having a predetermined area.

18. The vehicle of claim **17**, wherein an intermediate portion of the arm has a width greater than widths of other portions of the arm, and wherein the intermediate portion is connected to the bellows.

19. The vehicle of claim **15**, wherein the bellows has a bottom end fixed to the base and a top end connected to the support, and wherein, in response to the gas entering the bellows, the bellows is configured to stretch upward to pivot the support.

20. The vehicle of claim **15**, wherein the gas cartridge is fastened to the base through a cartridge bracket, the cartridge bracket being fixed to the base while surrounding the gas cartridge.

* * * * *